

The "umbrella spines" and other surface projections of some phasmid eggs and some comments on phasmid taxonomy

John Sellick, 31 Regent Street, Kettering, Northants, NN16 8QG, U.K.

Abstract

Short flat-topped spines are found in four tribes of Phasmida, widely separated in the traditional subdivision of the order. Pinnulae occur in *Phyllium siccifolium*. A survey is given of other surface projections of various types found in different families. A table of subfamilies is given, indicating some taxonomic problems.

Key words

Phasmida, egg structure, spines, hairs, pinnulae, *Bacteria*, *Baculum*, *Creoxylus*, *Datames*, *Dinophasma*, *Epidares*, *Haaniella*, *Hoploclonia*, *Paraphasma*, *Phenacephorus*, *Phyllium*, *Pseudophasma*, *Sipylloidea*, *Stratocles*.

Umbrella spines

I first noticed these structures when preparing s.e.m. images of two species of *Baculum* for my 1980 thesis. They stand around 0.15mm from the general egg capsule surface with a relatively narrow stalk and then expand into a more or less complex flattish top, the rim of which is composed of fused roughly spherical units. Reading recently Frédéric Langlois' account (1995) of the egg of *Stratocles tessulata* (Olivier) [as *Stratocles variegatus* (Stoll)] I saw there the same structures in an egg of a distinctly different group of phasmids. Langlois drew attention to the similarity of these structures in the two genera. He described them as "structures en forme de parapluie" (umbrella-like structures). Figure 1 shows the s.e.m. form of these "umbrellas".

I had noted their occurrence in *Paraphasma rufipes* (Redtenbacher), which like *Stratocles* is in the tribe Stratocleini, and in *Pseudophasma bispinosa* (Redtenbacher) in the Pseudophasmatini. Going to my reference collection I found them also in *Baculum cuniculum* (Westwood), *Baculum insignis* (Wood-Mason), *Baculum insueta* (Brunner), *Baculum* PSG 144 and *Baculum* PSG 157 in the Baculini, all of which are *Baculum* (iii), the third of the four strikingly different forms of eggs found within this "genus" (Sellick 1997). They are also in the *Creoxylus* sp. supplied to me by Oliver Zompro (his no.86) which is in the Xerosomatini. Here they are confined to the raised lines on the capsule surface, and form a ring on the operculum. I have not been able to detect them in all the species in my collection of *Baculum* (iii) or of *Creoxylus*. Stratocleini, Pseudophasmatini and Xerosomatini are closely related tribes (subfamily Bacunculinae), but in the traditional classification the Baculini are far separated from them (subfamily Phasmatinae). The first two tribes are Areolatae, whilst the Baculini is in the Anareolatae. Where else are these to be found? Similar structures occur in *Phyllium celebicum* (de Haan). These have shorter stalks (about 0.07mm) and complex heads (fig. 2A). The curious crusty surface of the egg of *Bacteria* PSG 152 (Subfamily Bacteriinae) is composed of the tessellated top plates of large umbrella spines (fig. 3). Like the others they stand around 0.15mm above the surface, their top plates being up to 0.35mm across, compared with 0.15 - 0.25mm in those species in other tribes where they do not form a full surface layer. The top plates are particularly large in a single layer surrounding the micropylar plate and along the opercular collar, where they form a series of open scales. Whilst the spines of Stratocleini, Xerosomatini and Baculini are so similar that they seem to indicate a close relationship, it is possible that those of Bacteriinae and Phylliidae with different dimensions are an accidental similarity of different origin.

The surface of the egg of *Phenacephorus cornucervi* (Brunner) (Lonchodinae) appears to be a pattern of rings with central depressions. Sectioning shows that these rings are produced by surface extensions with some similarity to umbrella spines in that they have stalks and an expanded head. They surround a thickening of the translucent compact layer of the capsule (fig. 5B). All the heads are however united into the ring formations, leaving

irregular openings which mark the circumferences of the rings (fig. 5A).

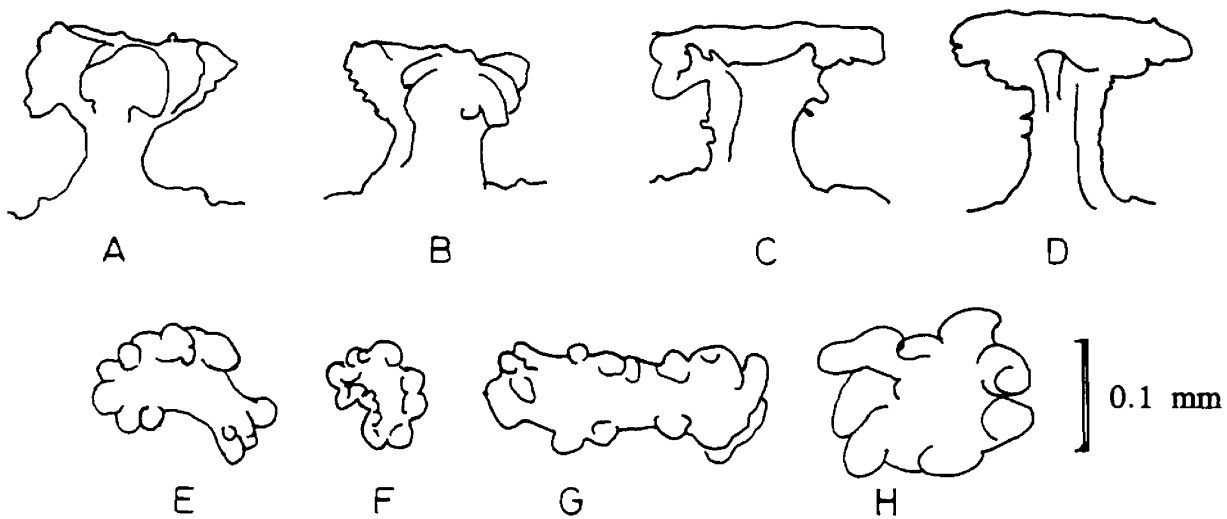


Figure 1. Umbrella spines.

A-D Side views: A. *Baculum thalii*. B. *Baculum cuniculum*. C & D. *Stratocles variegatus*.

E-H Surface views of *B. thalii*.

All traced from s.e.m. images (A-B, E-H Sellick 1980; C-D Langlois 1995).

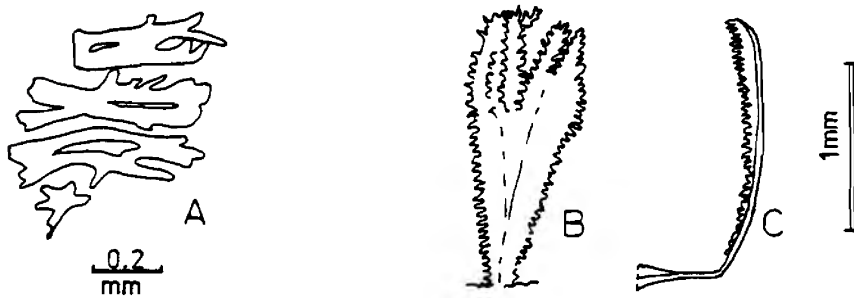


Figure 2. *Phyllium*.

A. Flat-headed spines in *P. celebicum* showing variety in shape and size of heads.

B & C. Pinnulae of *P. siccifolium*: B. side view of projecting portion. C. view showing base.

Pinnulae

I used this term in Sellick 1978 to describe the feather-like extension of the capsule and

operculum surface characteristic of *Phyllium siccifolium* (Linnaeus), but not so far found in any other species. These (figs. 2B & 2C) originate in a base some 0.5mm long which runs along the surface of the egg tapering from a broad origin almost to a point; it then extends outwards as a one- or two-branched flattened structure up to 1.6mm long and around 0.5mm wide which curves somewhat back in the direction of the base.

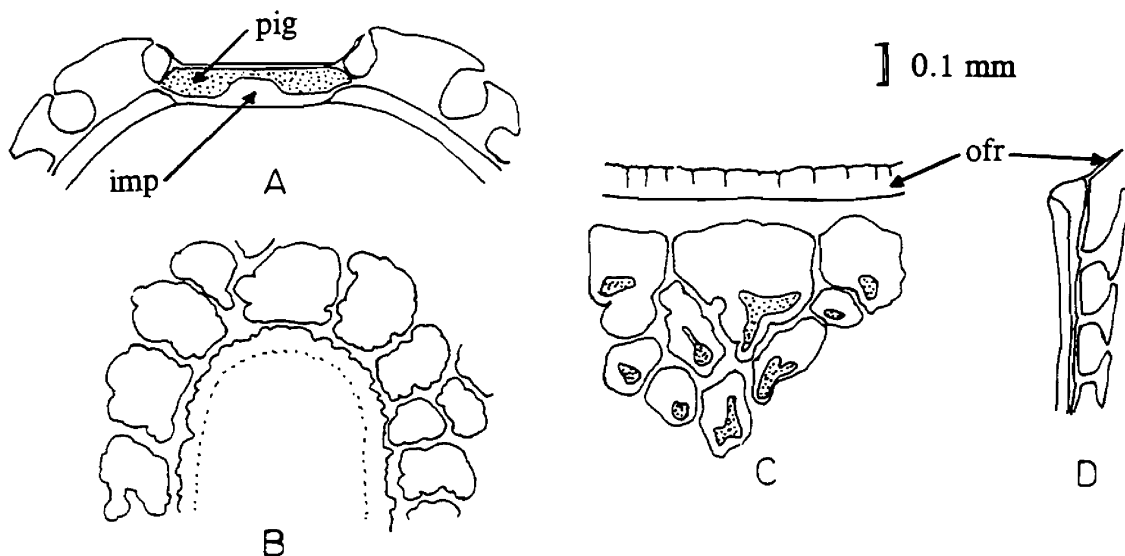


Figure 3. Umbrella spines forming the surface of the egg of *Bacteria* PSG 152.

A. Section through the micropylar plate.

B. Surface view of the area at the front of the micropylar plate.

C. Scale-like plates of the opercular collar seen in transparency, stalks of the plates are shaded.

D. Section of this region.

Drawings using a light microscope. pig = sunken pigmented surface layer over the plate, imp = internal micropylar plate, ofr = opercular fringe.

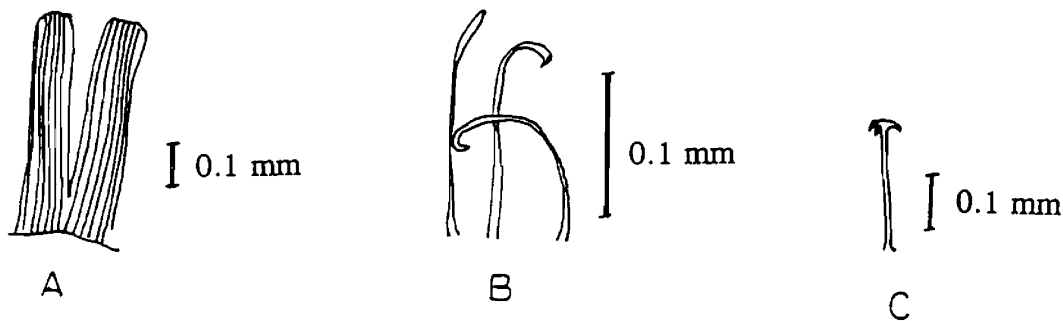


Figure 4.

A. Formation of collar fringes in *Diesbachia*.

B & C. Hairs of *Datamini*. B. *Epidares*. C. *Datames*.

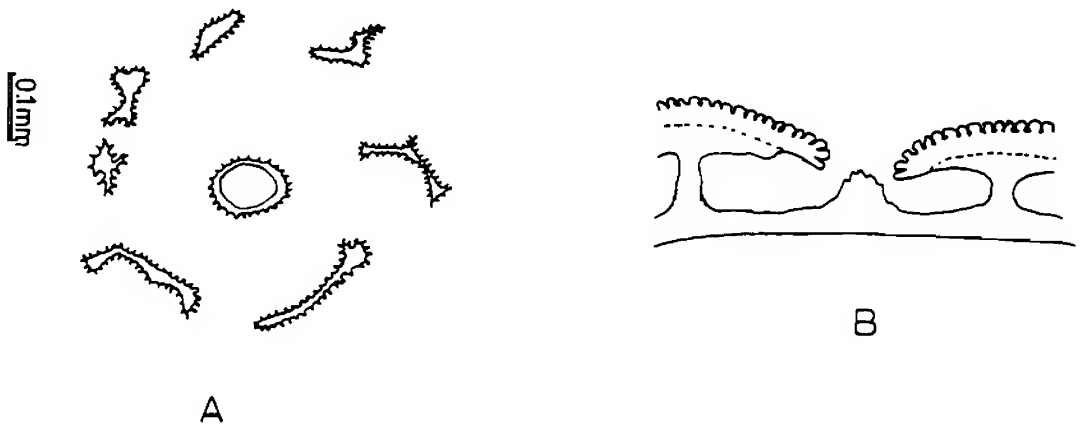


Figure 5. The surface of *Phenacephorus cornucervi*.
 A. Surface view showing "pit" and "ring".
 B. section through a pit and ring system.

Fringes of the capsule collar

A number of genera of the Necrosciidae possess fringes on the collar which surrounds the operculum. These are of various lengths, ranging from 0.3mm in *Orxines macklottii* (de Haan), through 0.5mm in *Acacus sarawacus* (Westwood) and 0.6mm in *Diesbachia tamyris* (Westwood), to 0.65mm in *Centrophasma hadrillus* (Westwood). The fringe material is traversed by some sixty thickened struts, each about 0.2mm wide and it then splits into separate fringes, each fringe containing usually two or three of these struts (fig. 4A). These are all true capsule outgrowths, and must not be confused with the fringe of *Trachythorax maculicollis* (Westwood), which is produced by a splitting away of the surface capsule layer. What appears to be a collar fringe in various species of *Baculum*, particularly PSG 157, is produced by variously developed umbrella spines and is opercular and not capsular.

Egg capsule hairs

Hairs of various types occur sporadically throughout the groups of phasmids. In *Orobia* sp. (from Madagascar) [Pygirhynchinae] there are short fine hairs ca. 0.03mm long. Three species of *Haaniella* [Heteropteryginae, Heteropterygini] show fine hairs of different lengths: 0.02mm in *H. echinata* (Redtenbacher), 0.07 mm in *H. grayii* (Westwood) and 0.13mm in Zompro's no.30. Similar fine hairs, 0.08mm long, are found in *Hoploclonia gecko* (Westwood) [Heteropteryginae, Obrimini]. Longer hairs, 0.18mm long, are found over the capsule and operculum surface of *Sipylodea ?sipylus* PSG 4. In the Heteropteryginae, Datamini three species show forms of hooked hairs. In *Datames oileus* (Westwood) these are sparse and 0.22mm long, expanded at the tip to form a three- (possibly four-) pronged top (fig. 4C). *Epidares nolimetangere* (de Haan) has a dense covering of long (0.4 - 0.45mm) hairs each with a single hook at the tip (fig. 4B). *Dinophasma guttigera* (Westwood) [Aschiphasmatinae, Aschiphasmatini] has a dense fine covering of 0.2mm hairs.

Comments on phasmid taxonomy

The division of the Phasmida into two on the basis of the presence or absence of triangular areas (the "area apicalis") on the mid- and hind-tibiae has been brought into question by a number of authors (e.g. Kristensen 1975, Key 1974, Roberts 1974), although retained by Kevan (1982) who, after the removal of *Timema* as the suborder Timematodea, divided his other suborder, the Phasmatodea, on conventional lines. Kristensen merely criticised the value of the area apicalis as a taxonomic criterion, pointing out that it may be sclerotised or not, elevated or depressed, and delimited by carinae, rows of spines, or have neither of these. He made no suggestion for regrouping within the order. Key suggested that the criterion for membership of the "Areolatae" should be the presence of a male vomer, on which basis he would transfer the Necrosiidae into that suborder. Roberts found vomers in Lonchodinae and Bacteriinae, both traditionally Anareolatae. These latter three groups are themselves at present in the two different superfamilies of the Anareolatae.

As an illustration of the chaos of phasmid classification, table 1 shows the 23 subfamilies of the Kevan classification, with some of their characteristics. Some of the names have been corrected following Bragg (1997), as they also have been in the above account. In no case is it to be taken that any of these characteristics is found throughout the subfamily in question.

Infraorder	Superfamily	Family	Subfamily	1	2	3	4	5
Timematodea	Timematoidea	Timematidae	---	+	-	-	X	ab
Bacillidea	Bacilloidea	Bacillidae	Bacillinae	+	+	-	O/C	+
			Pygrrhynchinae	+	+	-	C	ab
			Heteropteryginae	+	+	-	O	+/ab
		Pseudophasmatidae	Aschiphasmatinae	+	+	-	C	ab
			Korinninae	+	+	-	O	+
			Pseudophasmatinae	+	+	+	O	+/ab
	Phyllioidea	Phylliidae	---	+	+	+	C	ab
Phasmatidea	Heteronemioidea	Necrosiidae	---	ab	+	-	O/C	+/ab
		Heteronemiidae	Heteronemiinae	ab	-	-	O/C	+
			Libethrinae	ab	-	-	O	+
		Lonchodidae	Lonchodinae	ab	+	+?	O	+
			Menexeninae	ab	-	-	O/C	+/ab
		Pachymorphidae	Gratidiinae	ab	-	-	O/C	+/ab
			Pachymorphinae	ab	-	-	C	ab
		Palophidae	---	ab	-	-	O	ab
	Phasmatoidea	Bacteriidae	Cladoxerinae	ab	-	-	-	-
			Bacteriinae	ab	+	+	O	+/ab
		Phasmatidae	Platycraninae	ab	-	-	O/C	+/ab
			Xeroderinae	ab	-	-	-	-
			Eurycanthinae	ab	-	-	O	+
			Tropidoderinae	ab	-	-	C	ab
			Phasmatinae	ab	-	+	O/C	+/ab

Table 1. Phasmid subfamilies.

- 1 Area apicalis on tibiae
- 2 Male vomer
- 3 Egg umbrella spines
- 4 Internal micropylar plate type; X = no gap; O = open gap; C = closed gap
- 5 Median line: + = present in at least some genera; - = presence not known; ab = definitely absent in genera examined.

References

- Bragg, P.E.** (1997) *Phasmids of Borneo*, Ph.D. thesis, University of Nottingham.
- Kevan, D.K.McE.** (1982) Phasmoptera, in Parker, S.F. (Ed.) *Synopsis and Classification of Living Organisms*, Vol.2, McGraw Hill, New York et al. 379-382.
- Key, K.H.L.** (1974) in C.S.I.R.O. *Insects of Australia*, Supplement, Melbourne University Press.
- Kristensen, N.P.** (1975) The phylogeny of the hexapod 'orders'. A critical review of recent accounts. *Zeitschrift für die Zoologische Systematik und Evolutionsforschung*, **13**: 1-44.
- Langlois, F.** (1995) L'oeuf de *Stratocles variegatus* (Stoll, 1813). *Le Monde des Phasmes*, **29**: 3-9.
- Roberts, H.R.** (1974) Footnote in Key 1974.
- Sellick, J.T.C.** (1978) The eggs of leaf insects (Insecta: Phasmida). *Zoological Journal of the Linnean Society*, **63**: 249-258.
- Sellick, J.T.C.** (1980) A study of the eggs of the insect order Phasmida with particular reference to the taxonomic value of egg structure in this group, Ph.D. thesis, University of London, 349 pp.
- Sellick, J.T.C.** (1997 - in press) Descriptive terminology of the phasmid egg capsule, with an extended key to the phasmid genera based on egg structure. *Systematic Entomology*, **22**: 101-126.